

Amendments to the Specification

On page 1, line 3, after the Title of the Invention, please insert the following bolded caption and paragraph:

Cross Reference to Related Applications

This application is based on International Application No. PCT/NO2002/000477, filed 13 December 2002, having an International Publication Number of WO 2004/055322 A1 and an International Publication Date of 1 July 2004.

On page 1, lines 5-8, please replace the paragraph set forth therein with the following:

The present invention ~~regards~~ relates to the use of natural gas and air in the development of industry and oil fields. In particular, the invention ~~regards~~ relates to a method and a plant for integrated production of synthesis gas and air gas for synthesis of higher hydrocarbons and ~~utilising~~ utilizing surplus streams for injection into an oil reservoir.

On page 1, lines 11-14, please replace the paragraph set forth therein with the following:

Injection of various gases into an oil reservoir in order to enhance the oil recovery from the reservoir, and to ~~stabilise~~ stabilize it, has long been known and used. Gases such as CO₂, N₂ and natural gas will reduce the surface tension between gas and oil, and thus contribute to both increased recovery and ~~stabilisation~~ stabilization of the reservoir.

On page 1, line 34 to page 2, line 5, please replace the paragraph set forth therein with the following:

Separation of air into an "oxygen-depleted stream" and an "oxygen-enriched stream" is described in ~~US~~ U.S. Patents Nos. 5,388,645 and US 6,119,778. The oxygen-depleted stream is used for injection into a "solid carbonaceous formation" for improved recovery of ~~methane~~ methane, and at least a part of the oxygen-enriched stream is used for reaction with a reactant stream containing at least one oxidizable reactant. Examples of processes are ~~steel-making~~ steelmaking operations, production of non-ferrous metals, chemical oxidation processes and production of synthesis gas for Fischer-Tropsch synthesis of higher hydrocarbons from natural gas.

On page 2, lines 12-13, please replace the paragraph set forth therein with the following:

No other integration between the processes using the oxygen-depleted and oxygen-enriched streams is mentioned in ~~US~~ U.S. Patent Nos. 5,388,645 or US 6,119,778.

On page 3, lines 4-8, please replace the paragraph set forth therein with the following:

A process for preparation of higher hydrocarbons and for enhancing the production of crude oil from an underground formation is described in ~~CA~~ Canadian Patent No. 1,250,863. The off-gas from the synthesis plant is ~~oxidised~~ oxidized into mainly CO₂ and H₂O before it is injected into the underground formation. ~~Preferably~~ Preferably, the

presence of nitrogen is avoided by using oxygen from an air separation unit for all oxygen-demanding processes.

On page 3, lines 11-22, please replace the paragraph set forth therein with the following:

According to a first aspect of the present invention, there is provided a method for increasing oil recovery from an oil reservoir in which method gas is injected into the reservoir, comprising the steps of:

- ~~separation of~~ separating air into an oxygen-rich fraction and a nitrogen-rich fraction[[,]];
- providing a natural gas stream and leading the natural gas stream and at least a part of the oxygen-rich fraction to a reformer for conversion to synthesis gas mainly comprising H₂, CO and CO₂ and lower amounts of non-converted methane, water ~~vapour~~ vapor and nitrogen[[,]];
- ~~formation of~~ forming higher hydrocarbons from the synthesis gas in a synthesis unit[[,]];
- withdrawing raw synthesis products and a waste gas from the synthesis unit[[,]]; and
- injecting the nitrogen-rich fraction and at least a part of the waste gas into the oil reservoir to increase the oil recovery from the reservoir[[,]].

On page 5, line 21 to page 6, line 6, please replace the paragraph set forth therein with the following:

According to a fourth aspect of the present ~~invention~~ invention, there is provided a plant for providing gas for ~~downhole~~ down-hole injection for pressure support in an oil reservoir for ~~recovering~~ recovery of hydrocarbons and production of oxygenated hydrocarbons or higher hydrocarbons from natural gas, comprising:

- an air compression unit for production of compressed air for supply to processes that require a pure air stream;
- a reformer for conversion of a mixture of natural gas, water and air from the air compression unit into a synthesis gas comprising mainly N₂, H₂, CO, CO₂ and small amounts of methane;
- a ~~once-through~~ once-through synthesis unit for conversion of the synthesis gas for synthesis of higher hydrocarbons;
- means for injecting gas into the reservoir; and
- [[~~-~~ and]]
- means for transferring at least a part of a nitrogen-rich waste gas from the synthesis unit to the means for injecting gas.

On page 6, lines 17-20, please replace the paragraph set forth therein with the following:

More detailed ~~utilisation~~ utilization of some of these possibilities can be illustrated by the examples below. It should be ~~recognised~~ recognized that there are multiple ways to combine the described injection gases, both by mixing with natural gas[[.]] and by applying intermittent operation, also using water part of the time.

On page 11, lines 19-21, please replace the paragraph set forth therein with the following:

The ~~cooled-down~~ cooled-down syngas leaves the cool-down unit 52 through a line 42 and is passed through a membrane unit 43 where hydrogen is separated from the syngas to give a an H₂/CO ratio that is useful for the further reactions.

On page 11, lines 23-28, please replace the paragraph set forth therein with the following:

The decant water separated from the syngas is led through line 49 to the EOR ~~6~~ 6, and hydrogen is withdrawn through line 48 and can be used as fuel gas or for feed gas ~~desulfurisation~~ desulfurization or hydrotreating/hydrocracking of oils fractions. The syngas leaving the membrane unit 43 through a line 44 is introduced into a Fischer-Tropsch (FT) synthesis loop 56 for production for higher hydrocarbons. Higher hydrocarbons in the present description are hydrocarbon molecules having three or more carbon atoms, more preferably five or more carbon atoms.

On page 11, lines 33-34, please replace the paragraph set forth therein with the following:

Raw higher hydrocarbon product from the FT synthesis loop 56 is ~~withdraw~~ withdrawn through a line ~~57~~ 57, and the produced water is withdrawn through a line 58 and passed to the EOR 6.

On page 12, lines 9-13, please replace the paragraph set forth therein with the following:

The remaining tail gas, or the ~~hydrogen-poor~~ hydrogen-poor fraction, in line 65 may be split into two streams, one in a line 59 that is introduced to the EOR and another stream in a line 45 that is used as fuel for a power generation unit 46. The ~~tailgas~~ tail gas introduced into the power generation unit 46 is burned in the presence of air or ~~oxygen-enriched~~ oxygen-enriched air to produce power or heat. Flue gas from the power generation unit 46 is led through a line 47 to the EOR 6 for injection.

On page 12, lines 18-28, please replace the paragraph set forth therein with the following:

The present ~~invention~~ invention, in its different embodiments, also makes it possible to ~~customise~~ customize the plant and respectively alter the working conditions according to the specific ~~need and / or~~ and/or variations in economical and technical factors.

Some advantages ~~by~~ of using the embodiment according to figure 2 are listed below:

- Water injection.

Water or steam are generated in several places in the GTL plant. ~~First~~ First, it should be ~~recognised~~ recognized that steam is generated at elevated pressures and temperatures. In particular, the elevated pressure will be an advantage for EOR, as work for compression to the desired injection pressure will be reduced. Often the energy content of the steam is ~~utilised~~ utilized in a steam turbine to produce electricity or for heat input to process units like distillation towers, whereby the steam may be condensed to water.

On page 12, line 30, please replace the paragraph set forth therein with the following:

Water/steam is produced (~~synthesised~~ synthesized) in the FT reactor by the reaction:

On page 13, lines 3-13, please replace the paragraph set forth therein with the following:

In other words, water or steam is ~~synthesised~~ synthesized in the same amount on a molar basis as the number of $[-CH_2]$ $-CH_2$ units in the hydrocarbon product. This will be ca. double the amount of oxygen (mole) produced by the ASU, or half the amount of nitrogen (excluding oxygen loss to ~~CO_2~~ CO_2 in the calculation). It should also be understood that there is a significant use of boiler feed water for steam generation in ~~[[a]]~~ an FT-plant, notably in the heat exchanger for the FT-reactors themselves and to cool down the synthesis gas. Furthermore, there is also a significant use of cooling water in an ~~F-T plant~~ FT-plant. The water generated in the FT reaction will unavoidably contain small amounts of impurities comprising alcohols, acids and other oxygenates that often will have to be removed in costly water treatment ~~facilities~~, facilities before disposal. This purification may not be necessary if the water is used for EOR.

On page 13, lines 16-19, please replace the paragraph set forth therein with the following:

As described in Example A, steam is generated in several places in the GTL plant. As such, this is a valuable product that at least partly may be used to produce electric

power. Particularly in a remote ~~location there~~ location, it may be more feasible to use steam for EOR.

On page 14, lines 4-8, please replace the paragraph set forth therein with the following:

Unless the intention of the EOR operation is simple gravity ~~stabilization~~ stabilization, that is is, gas compression from top to bottom of the oil reservoir, it frequently is an advantage if the gas has a high miscibility with the oil. Nitrogen has low miscibility, and methane somewhat higher, whereas ~~CO₂~~ CO₂ and higher hydrocarbons (C₂+) are more easily mixed with the oil.

On page 14, lines 10-21, please replace the paragraph set forth therein with the following:

It is well known that ~~optimisation~~ optimization of an a GTL-plant will comprise recycle streams, e.g. recycle of the ~~tail-gas~~ tail gas (light off-gas) from the FT-reactor to the syngas unit or back to the FT-reactor, in order to increase overall energy and carbon efficiency. This tail gas from the FT-reactor, usually after separation of the main products (C₅+) and water, then will contain ~~CO₂~~ CO₂, light hydrocarbons, and unconverted syngas. ~~Whole~~ All or part of the tail gas can be used for EOR, possibly after mixing it with nitrogen, natural gas or ~~CO₂~~ CO₂ from a dedicated ~~CO₂~~ CO₂ separation unit. Now it may be a disadvantage, particularly for moderate conversion in the FT-reactor, that the tail gas contains unconverted syngas. One option therefore is to pass the gas through an additional syngas conversion unit, like a second FT-reactor, to

secure high conversion before EOR. Hydrogen may also be removed in a dedicated unit, for instance a polymer membrane separator, and CO converted to CO_2 CO_2 and hydrogen in a shift reactor.

On page 14, lines 23-27, please replace the paragraph set forth therein with the following:

Using the Fischer-Tropsch tail gas for EOR opens up the possibility for a significant simplification and cost reduction for the GTL plant. In fact, a once-through concept might be feasible. No recycle also opens up the possibility for a simplified ASU using only enriched air for an ATR syngas generator. This enriched air may contain 25 % nitrogen that will end up in the tail gas and thereby the EOR stream.

On page 15, lines 14-19, please replace the paragraph set forth therein with the following:

A simulation on a plant as illustrated in figure 2 was performed. 367 000 Sm^3/hr natural gas from line 9 was mixed with 183 t/h steam from line 50 in order to reach ~~steam-to-carbon~~ a steam-to-carbon ratio of 0.6. The mixture was preheated to 600°C and fed to an auto-thermal reformer (ATR) 8. 275 t/hr oxygen (6600 MTPD) was introduced into the ATR 8 from the line 7. The outlet temperature from the ATR 8 was 1030°C. The amount of oxygen consumed in the ATR corresponds to a co-production of N_2 of 39600 MTPD.

On page 15, lines 21-25, please replace the paragraph set forth therein with the following:

The syngas leaving the ATR 8 through line 12, which is in equilibrium and at a temperature of around 1030°C, is cooled to about 350°C with evaporating water in the syngas ~~cool-down~~ cool-down unit 52 producing about 830 t/h saturated 110 bar steam that is withdrawn in line 54. The steam in line 54 may be ~~utilised~~ utilized for EOR as illustrated in figure 4, or in turbines to generate power.

On page 16, lines 9-12, please replace the paragraph set forth therein with the following:

To ~~maximise~~ maximize the amount of CO₂ available for recovery from the gas in line 65, the gas may be shifted with a low-temperature copper catalyst to convert about 86% of the CO into CO₂. A CO₂ recovery of 95% will then imply that 180 t/hr CO₂ is available for EOR ~~purpose~~ purposes from the gas in line 65.

On page 17, line 1, please replace the paragraph set forth therein with the following:

Claims We Claim: